

NISTTech

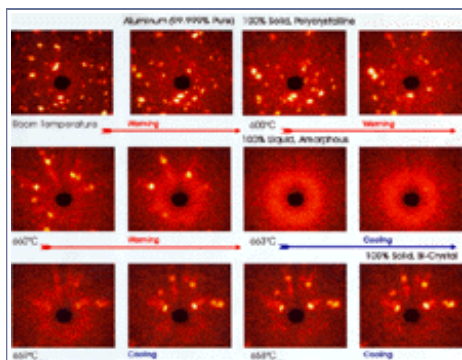
Apparatus & Method for Monitoring Casting Process

Inexpensive, non-invasive view of solid/liquid phases in high heat casting processes

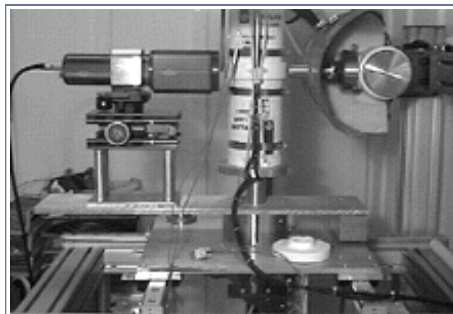
Description

This system monitors the melting process of single-crystal metal castings even when the metals are encased by thick ceramic molds. This noninvasive monitoring technique uses high energy x-rays in the 50 keV to 320 keV range to transmit x-ray diffractions from specimens without encountering interference from furnaces or molds. Laue diffraction images (when a stationary crystal is illuminated with x-rays from a continuous range of wavelengths) distinguish between the solid or liquid states of the metal casting and measure the fraction of remaining solid. Clear images display the solid and liquid phases of single crystals samples more than 6 mm thick.

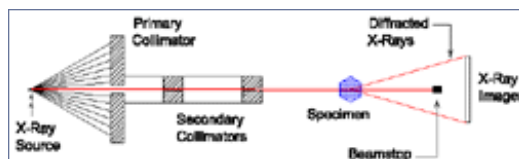
Images



The sequence of transmission Laue diffraction patterns (160 kV, 1 mA) obtained as a polycrystalline aluminum rod was heated, melted, and then cooled.



The apparatus for observing transmission diffraction during melting and solidification.



Components of the real-time, high-energy transmission diffraction apparatus.

Applications

- **Foundries and metal processors**
Minimizes the risk of imperfections in metals made during the casting

process at foundries

Advantages

- **Cost effective**
This procedure saves money and minimizes energy use by determining exactly when a casting has reached the critical point in solidification
- **Quality control**
Enhances the quality of castings

Abstract

The present invention uses a high energy x-ray, neutron, or gamma source for monitoring the interface between a molten and solidified crystalline phase while in a furnace in a casting process. The radiation can also be used to determine the quality and orientation of the crystals in the crystalline phase. The invention uses the distinctive diffraction patterns produced by crystalline and amorphous phases to locate the interface.

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Citations

1. D.W. Fitting, W.P. Dubé, and TA. Siewert. Transmission x-ray diffraction for real-time sensing of the solidification of a casting. Proc. SPIE, Vol. 2940, pp. 158-164.

References

- U.S. Patent # 5,589,690
- Docket: 94-021US

Status of Availability

This invention is available for licensing.

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